System and Method for Generating a Bill of Quantities

FIELD OF INVENTION

The invention relates broadly to a system and method for generating a bill of quantities associated with a construction project, and to a data storage medium having stored thereon computer code means for instructing a computer to execute a method of generating a bill of quantities associated with a construction project.

BACKGROUND

Bill of quantities are contractual documents for all constructions project. They are important documents describing the works and specifying the required workmanship of each construction project. Typically, many of the activities in relation to the construction project such as progress payments, variations claims and final accounts are prepared based on the bill of quantities.

By their very nature, bills of quantities are complex documents, the preparation of which is typically performed by a team of people, including quantities surveyors. The preparation requires an in-depths knowledge of the structure and coding used in the bills of quantities, which are typically regulated through appropriate authorities, often under government control.

At the same time, the increasing competitiveness in relation to the awarding of construction projects, in particular large scale construction projects, has increased the pressure on construction organizations to be cost and time efficient. Thus the complex and time consuming task of producing bills of quantities can present a major obstacle for the construction organizations to meet those competitive demands.

A need therefore exists to provide a system and method for generating a bill of quantities associated with a construction project, which seek to address at least one of the above-mentioned problems.

SUMMARY

In accordance with a first aspect of the present invention there is provided a system for generating a bill of quantities associated with a construction project, the system comprising a first database for storing object oriented design data representing the construction project; a second database for storing a standard-based description associated with respective objects in the object oriented design data, the standard-based description identifying standardised object properties associated with corresponding construction objects in the construction project; and a generator for generating the bill of quantities based on the bill of qualities description library.

The second database may comprise first and second database components, the first database component for storing standard-based identification codes associated with the respective design objects in the object oriented design data, and the second database component for storing standard-based description information associated with corresponding construction objects in the construction project indexed by the same standard-based identification codes.

The first database component may further store a first part of a total of the standard-based description information, and the second database component stores a second part of the standard-based description information.

The system may further comprise a first application macro for defining the standard-based identification codes and the first part of the standard-based description information for selected design objects for storing in the first database component.

The system may further comprise a second application macro for defining the second part of the standard-based description information for selected design objects for storing in the second database component.

The system may further comprise an object oriented design module coupled to the first data base for generating the object oriented design data.

The second database may further store non-standardised description elements chosen for further facilitating generating the bill of quantities.

The system may further comprise an assignment module for assigning selected data from the second database to respective objects in the object oriented design data and for assigning formulas for quantity take-off.

In accordance with a second aspect of the present invention there is provided a method for generating a bill of quantities associated with a construction project, the method comprising storing object oriented design data representing the construction project in a first database; storing a standard-based description associated with respective objects in the object oriented design data in a second database, the standard-based description identifying standardised object properties associated with corresponding construction objects in the construction project; and generating the bill of quantities based on the bill of qualities description library.

The second database may comprise first and second database components, the method comprises storing standard-based identification codes associated with the respective design objects in the object oriented design data in the first database component, and storing standard-based description information associated with corresponding construction objects in the construction project indexed by the same standard-based identification codes in the second database component.

The method may further comprise storing a first part of a total of the standard-based description information in the first database component, and storing a second part of the standard-based description information in the second database component.

The method may further comprise providing a first application macro for defining the standard-based identification codes and the first part of the standard-based description information for selected design objects for storing in the first database component.

The method may further comprise providing a second application macro for defining the second part of the standard-based description information for selected design objects for storing in the second database component.

The method may further comprise providing an object oriented design module coupled to the first data base for generating the object oriented design data.

The method may further comprise storing non-standardised description elements chosen for further facilitating generating the bill of quantities in the second database.

The method may further comprise assigning selected data from the second database to respective objects in the object oriented design data and assigning formulas for quantity take-off.

In accordance with a third aspect of the present invention there is provided a data storage medium having stored thereon computer code means for instructing a computer to execute a method of generating a bill of quantities associated with a construction project, the method comprising the steps of storing object oriented design data representing the construction project in a first database; storing a standard-based description associated with respective objects in the object oriented design data in a second database, the standard-based description identifying standardised object properties associated with corresponding construction objects in the construction project; and generating the bill of quantities based on the bill of qualities description library.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 shows a schematic drawing of a system for generating a bill of quantities associated with a construction project.

Figure 2 shows a schematic drawing of a computer system for implementing the system of Figure 1.

Figure 3 shows a schematic functional flowchart of a method and system for generating a bill of quantities associated with a construction project.

Figures 4 to 10 show the series of screen shots illustrating building of components in a first database component of the example embodiment.

Figures 11 to 17 show a series of screen shots illustrating building of parts in a first database component of the example embodiment.

Figures 18 to 27 show a series of screen shots illustrating built up of a second database component in the example embodiment.

Figure 28 is a schematic drawings illustrating "parts" and "components" libraries in a Building Information Model (BIM) software.

Figure 29 shows a schematic drawing illustrating a part library and component library structure of a BIM software.

Figures 30 to 32 show a series of screen shots illustrating a signing of families, parts, components and formula in the example embodiment.

Figures 33 to 40 show a series of screen shots illustrating generation of bills of quantities in the example embodiment.

DETAILED DESCRIPTION

Some portions of the description which follows are explicitly or implicitly presented in terms of algorithms and functional or symbolic representations of operations on data within a computer memory. These algorithmic descriptions and functional or symbolic representations are the means used by those skilled in the data processing arts to convey most effectively the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities, such as electrical, magnetic or optical signals capable of being stored, transferred, combined, compared, and otherwise manipulated.

Unless specifically stated otherwise, and as apparent from the following, it will be appreciated that throughout the present specification, discussions utilizing terms such as “coding”, "building up", “calculating”, “determining”, “generating”, “outputting”, or the like, refer to the action and processes of a computer system, or similar electronic device, that manipulates and transforms data represented as physical quantities within the computer system into other data similarly represented

as physical quantities within the computer system or other information storage, transmission or display devices.

The present specification also discloses apparatus for performing the operations of the methods. Such apparatus may be specially constructed for the required purposes, or may comprise a general purpose computer or other device selectively activated or reconfigured by a computer program stored in the computer. The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose machines may be used with programs in accordance with the teachings herein. Alternatively, the construction of more specialized apparatus to perform the required method steps may be appropriate. The structure of a conventional general purpose computer will appear from the description below.

In addition, the present specification also implicitly discloses a computer program, in that it would be apparent to the person skilled in the art that the individual steps of the method described herein may be put into effect by computer code. The computer program is not intended to be limited to any particular programming language and implementation thereof. It will be appreciated that a variety of programming languages and coding thereof may be used to implement the teachings of the disclosure contained herein. Moreover, the computer program is not intended to be limited to any particular control flow. There are many other variants of the computer program, which can use different control flows without departing from the spirit or scope of the invention.

Furthermore, one or more of the steps of the computer program may be performed in parallel rather then sequentially. Such a computer program may be stored on any computer readable medium. The computer readable medium may include storage devices such as magnetic or optical disks, memory chips, or other storage devices suitable for interfacing with a general purpose computer. The computer readable medium may also include a hard-wired medium such as exemplified in the Internet system, or wireless medium such as exemplified in the GSM mobile telephone system. The computer program when loaded and executed on such a general-purpose computer effectively results in an apparatus that implements the steps of the preferred method.

Figure 1 shows a schematic drawing of a system 100 for generating a bill of quantities associated with a construction project, in accordance with an embodiment of the present invention. The system 100 comprises a first database 102 for storing

object oriented design data representing the construction project. The system 100 further comprises a second database 104 for storing a standard-based description associated with respective design objects in the object oriented design data, the standard-based description identifying standardized object properties associated with corresponding construction objects in the construction project. The first database 102, and the second database 104 are coupled to a generator module 106 for generating the bill of quantities 108 based on data extracted from the first and second databases 102, 104. In the example embodiment, the second data base 104 is implemented in two components 110 and 112.

The method and system of the example embodiment can be implemented on a computer system 200, schematically shown in Figure 2. It may be implemented as software, such as a computer program being executed within the computer system 200, and instructing the computer system 200 to conduct the method of the example embodiment.

The computer system 200 comprises a computer module 202, input modules such as a keyboard 204 and mouse 206 and a plurality of output devices such as a display 208, and printer 210.

The computer module 202 is connected to a computer network 212 via a suitable transceiver device 214, to enable access to e.g. the Internet or other network systems such as Local Area Network (LAN) or Wide Area Network (WAN).

The computer module 202 in the example includes a processor 218, a Random Access Memory (RAM) 220 and a Read Only Memory (ROM) 222. The computer module 202 also includes a number of Input/Output (I/O) interfaces, for example I/O interface 224 to the display 208, and I/O interface 226 to the keyboard 204.

The components of the computer module 202 typically communicate via an interconnected bus 228 and in a manner known to the person skilled in the relevant art.

The application program is typically supplied to the user of the computer system 200 encoded on a data storage medium such as a CD-ROM or flash memory carrier and read utilising a corresponding data storage medium drive of a data storage device 230. The application program is read and controlled in its execution by the processor 218. Intermediate storage of program data maybe accomplished using RAM 220.

The inventor have recognized that in order to address one or more of the problems described in the background section, a method and system for generating a bill of quantities associated with a construction project can be provided which "links" object orientated design data available for a construction project in an automated fashion to the generation of the bill of quantities. The method and system in the example embodiment utilize databases and application macros for building up standard-based description libraries. The example embodiment will be described herein with reference to an existing object oriented design software package provided by Bentley, namely Bentley Architecture v8.

Figure 3 illustrates a functional flow-chart 300 for the method and system of the example embodiment. As part of a construction project, a number of objects 302 and their associated properties need to be decided. As illustrated in Figure 3, there are a plurality of properties e.g. 304 associated with the object 302, all of which make up the definition or recipe for the object 302. More particular, the properties shown in Figure 3 include a description property 304, a rate property 306, a location property 308, a material property 310, a layering property 312, a dimension property 314, an industry foundation class (IFC) property 316, and a type property 318.

The design of the object 302 is performed on an object oriented computer assisted design (OOCAD) software or building information modeling (BIM) software 320 in the example embodiment. As would be appreciated by a person skilled in the art, of the properties associated with the object 302, one or more can be relevant to the generation of a bill of quantities. Perhaps most significantly, the description property 304 functions as one of the main identification properties of the object 302, and it is therefore desirable that the description property 304 follows a standard description library coding system 322 in the example embodiment. In the BIM software 320 used in the example embodiment, a first database component has been developed and is build-up by a dedicated macro written by the inventor, utilizing the macro platform provided as part of the BIM software 320. As an output from the so modified software 320, a standard-based description report in the form of a report generated in Excel format 324 can be generated.

Furthermore, a second database component has been developed and is build up by a dedicated macro written by the inventor utilizing the macro platform

provided in Microsoft Access. This second database component is utilized for building up a bill of quantities description in the form of a standard library database in Access format 326 based on the report generated in Excel format 324. Bills of quantities generated in Excel format 328 are generated based on the standard library database in Access format 326, utilizing a macro written by the inventor on the macro platform of the BIM software 320. The first and second database components are linked in the example embodiment utilizing standard-based identification codes from the standard description library coding system 322. In particular, the first database component stores standard-based identification codes associated with the respective design objects corresponding to the construction objects 302 together with a first part of a total standard-based description information, while the second database component stores a second, larger part of the standard-based description information indexed by the same standard-based identification codes.

As mentioned above, there typically are more then one standard-based properties associated with each object 302. For example, in addition to the description property 304, one or more of the rate property 306, and the layering property 312 may be standard-based. As would be appreciated by the person skilled in the art, further databases and dedicated macros may be implemented in different embodiments to incorporate the respective object properties into the bills of quantity generation, in the same fashion as described above with reference to the description property 304. Such standard-based properties can contribute to a bill of quantities as the ultimate output.

In the following, the example embodiment will be described in more detail with reference to the screen shot shown in Figures 4 to 39. In the BIM software used in the example embodiment, "parts" at "components" are associated with design objects of a particular design. For example, as shown in Figure 28, parts such as roof 2800, or window 2802 of a building design 2804 can be linked to components such as asphalt 2806, labour 2808 or concrete 2809 and corresponding specifications 2810, 2812, 2813 of the components 2806, 2808, 2809. In the example embodiment, a customised first database component implemented on the BIM platform of "parts" and "components" is utilised to assign standard-based information to respective design object of a design created in BIM, for later extraction as part of an automated bill of quantities generation, and in conjunction with a second database component implemented in Microsoft Access.

Build up of first database component

Building components

From the BIM software interface 400 as shown in Figure 4, the TriForma icon 402 on the menu bar 404 is clicked, and "libraries" followed by "components" are selected from the dropdown lists 406, 408. On the component management panel 500 shown in Figure 5, "new" button 501 is clicked to build up components according to the trades in a relevant standard. In the described examples, the standard is the *Singapore Standard CP 97: Part 1: 2002 Code of Practice for Construction Electronic Measurement Standards (CEMS) Part 1: Standard Method of Measurement (SMM) for building works.* "New" button 503 is clicked on the create new family panel 502 to create a new dataset file.

On the select dataset file panel 600 shown in Figure 6, the relevant trade code, for example the trade code for concrete works, in this case "CEMS-05000000.xml" is keyed into the field 602, followed by clicking of the OK icon 604. A new dataset file is thus created, and displayed in a dataset file display 700 of a create new family panel 702. The newly created dataset file 704 is selected, and the name or code 800 keyed in on the created new family panel 702 as shown in Figure 8. A description 802 is also keyed in, followed by clicking the OK icon 804. In the example embodiment, the name or code 800 and the description 802 are based on the CEMS. It is noted that in the BIM software used in the example embodiment, input of colon ":" is not allowed. Therefore, in the example embodiment the name or code 800 is initially entered using a full stop "." in place of the colon ":", and later changed using XML notepad. Furthermore, it will be appreciated that the description 802 may be chosen, and if necessary shortened, to meet a given limitation on the number of input characters, for example 73 in the BIM software.

The family component 900 being created will next appear on the component manager panel 500 as shown in Figure 9. At this stage, the components field 902 associated with the family component 900 being created will appear empty for a new family component. Clicking on the add button 904 activates the edit component panel 1000 as shown in Figure 10. On the edit component panel 1000, the name (e.g. 01) at field 1002, and the description (e.g. "generally"), at field 1004 are entered, and the relevant unit selected from the unit dropdown field 1006. It is noted that in the example embodiment, units such as No., Item, Pairs and Sum are not available, but can be readily represented using Pc (for 'piece') to represent those units when necessary. The save button 1008 is then clicked to save the added

component. Existing components may be edited using the edit button 906 (Figure 9). The steps described above with reference to Figures 9 and 10 are repeated to build up more components for the family component being created.

In addition to changing the full stops "." to semi-colons ";" as mentioned above with reference to Figure 8, in the example embodiment XML notepad can be utilised to edit or replicate a component family or component conveniently, as will be appreciated by a person skilled in the art.

Building parts

In the example embodiment, building up parts for the first database component is implemented in a similar fashion to the building of components described above with reference to Figures 4 to 10, and will now be described with reference to Figures 11 to 17.

From the BIM software interface 1100 as shown in Figure 11, the TriForma icon 1102 on the menu bar 1104 is clicked, and "libraries" followed by "parts" are selected from the dropdown lists 1106, 1108. On the part management panel 1200 shown in Figure 12, "new" button 1201 is clicked to build up parts according to the trades in the CEMS. "New" button 1203 is clicked on the create new family panel 1202 to create a new dataset file.

On the select dataset file panel 1300 shown in Figure 13, the relevant trade code, for example the trade code for concrete works, in this case "CEMS-05000000.xml" is keyed into the field 1302, followed by clicking of the OK icon 1304. A new dataset file is thus created, and displayed in a dataset file display 1400 of a create new family panel 1402. The newly created dataset file 1404 is selected, and the name or code 1500 keyed in on the created new family panel 1502 as shown in Figure 15. A description 1504 is also keyed in, followed by clicking the OK icon 1506. In the example embodiment, the name or code 1500 and the description 1504 are based on the CEMS. Again, it is noted that in the BIM software used in the example embodiment, input of colon ":" is not allowed. Therefore, in the example embodiment the name or code 1500 is initially entered using a full stop "." in place of the colon ":", and later changed using XML notepad. Furthermore, it will be appreciated that the description 1504 may be chosen, and if necessary shortened, to meet a given limitation on the number of input characters, for example 73 in the BIM software.

The family part 1600 being created will next appear on the part manager panel 1200 as shown in Figure 16. At this stage, the parts field 1602 associated

with the family part 1600 being created will appear empty for a new family part. Clicking on the add button 1604 activates the edit part panel 1700 as shown in Figure 17. On the edit part panel 1700, the name (e.g. "03-Pile caps") at field 1702 is entered. The save button 1708 is then clicked to save the added part. Existing parts may be edited using the edit button 1606 (Figure 16). The steps described above with reference to Figures 16 and 17 are repeated to build up more parts for the family component being created.

In addition to changing the full stops "." to semi-colons ";" as mentioned above with reference to Figure 15, in the example embodiment XML notepad can be utilised to edit or replicate a component family or component conveniently, as will be appreciated by a person skilled in the art.

Build up of second database component

The second database component in the example embodiment is implemented in Microsoft Access. On the user interface 1800 shown in Figure 18, the File icon 1802 is selected, and "New" selected from the drop-down list (not shown). Blank Database 1804 is then clicked on the new file panel 1806 to create a blank access database, and a File New Database dialog box 1808 is displayed. The drop-down arrow 1810 is clicked for selection of the appropriate drive for storing the second library component. The file name e.g. "db1.mdb" is keyed in at the file name field 1812, and the create button 1814 clicked. The created new database can then be selected, and a database window panel 1900 will be displayed upon selection, as shown in Figure 19. The New button 1902 is then clicked to display the new table dialog box 1904. Create Table in Design View 1906 is selected from the new table dialog box 1904 and confirmed by clicking the OK button 2000 in the new table panel 2002, as shown in Figure 20.

A Microsoft Access Datasheet View 2100 is then displayed as shown in Figure 21. FamilyID is typed under field name 2102, and the Tab key is pressed to move to Data Type column 2104. The down-arrow on the drop-down list box 2106 is clicked, and AutoNumber or Number selected. It is noted here that in the example embodiment, Microsoft Access does not allow any spacing in the field name. However, after clicking the Caption box 2108 in the properties area, "Family ID" with space can be entered, so that it will appear in that fashion in the data sheet view 2400 (Figure 24). A similar procedure will be carried out for the rest of the field names in column 2102.

Next, FamilyCode 2200 as a Text field 2202 are added to the table, as shown in Figure 22. A Field Size 2204 is set to "8", and "Family Code" is entered at the caption field 2206. "Yes" is selected under the required field box 2208.

FamilyDescription 2300 as a Text field 2302 is added to the table as shown in Figure 23. ">" is entered in the Format box 2304 in the properties area to display the data entered in uppercase. "Family Description" is entered under the caption box 2306, and "yes" selected under the required field box 2308. The pull down menu (not shown) of the View icon 2310 is then selected and Datasheet View clicked to change to the datasheet view for a selected record, for example the Family ID record 2402, as shown in Figure 24. The Tab key, the right arrow key or the enter key can be used to move to the relevant field to enter the relevant information, for example "04000000" in the Family Code field 2404 to follow the CEMS work section coding for excavation works, followed by entering "Excavation Works" under the family description field 2406. Similarly, a Family Code of "05000000" can be entered in the Family Code field 2408, followed by entering "Concrete Works" in the family description field 2410.

To create a "Category" table in the same database, corresponding procedures to the one described above with reference to Figures 21 to 24 are followed, and the FamilyID 2500 as a Number field 2502 is added to the category table 2504 as shown in Figure 25. Again, in the data sheet view 2600 shown in Figure 26, the Tab key, the right arrow key or the enter key can be used to move to the category code field 2602. For example, "00" can be entered as the category code 2602, and "*" for the category description 2604, and "1" under the Family ID field 2606. The remaining data can then be entered following the phraseology in the first database component created and used in the modified BIM.

Other tables for e.g. sub-category, description and note can be created following a similar procedure as the one described above with reference to creating a "category" table. The created tables e.g. 2700 (category), 2702 (description), 2704 (families), 2706 (notes) and 2708 (sub-category) will be displayed in the Microsoft Access table panel 2710 as shown in Figure 27, and can provide a full standard-based description. As such, it will be appreciated that in the example embodiment, the first and second database components, which are linked by the standard-based identification codes from the standard description library coding system 322 (Figure 3), together provide a "total" standard-based description information, which is utilised in an automated bill of quantities generation. Furthermore, in the example

embodiment the second database component further stores non-standardised description elements chosen for further facilitating generating a more meaningful bill of quantities, compared to bill of quantities only based on standard description information used in the standard description library coding system 322 (Figure 3).

In the example embodiment, the second database component is based on CEMS as mentioned above. Figure 29 shows an example coding sheet 2900 for concrete works in CEMS. In the second database component, the families table 2704 (Figure 27) represents the work sections 2902, and the categories stable 2700 (Figure 27) corresponds to the sub heading numbers 2904, if any. The sub-categories table 2708 (Figure 27) corresponds to the numbers from the first column 2906, the description table 2702 (Figure 27) corresponds to the numbers from the second column 2908. The note1 table 2706 (Figure 27) corresponds to the numbers from the third column 2910. A note2 table (not shown in Figure 27), which can be created in the same fashion as described above with reference to creation of the note1 table 2706 (Figure 27) corresponds to the number from the fourth column 2912.

Assigning family, parts, components and formulas

Typically, before any measurement on a design being created, levels or layers that are not to be considered for a particular measurement are filtered off in order to gain a better view of the elements which are to be quantified. In the BIM software, those elements are typically referred to as active level AL.

In the representation of an active level e.g. 3000 as shown in Figure 30, the element information icon 3002 is clicked and the family selected from the dropdown field 3004. As previously described, a family represents a group of parts, for example if one is measuring the concrete of the foundation, the family code for the concrete works trade is selected as the family, i.e. 05000000, based on CEMS in the example embodiment.

Next, the appropriate part of the family or group of parts is selected from the dropdown field 3006. For example, "pile caps" may be selected as the part.

In the example embodiment, the part definition links the components to the design objects that are to be quantified. In turn, the components determine the unit of measurement and the unit price that is used to apply material take-offs. Components are thus linked two parts through a formula. The formula determines how to physically measure that element. For example, a pile cap can measure in two ways, the volume for concrete, and the area for formed work.

To assign components and formulas, TriForma icon 3008 is selected, and libraries followed by parts chosen in the subsequent drop-down menus (not shown). The part manager panel 3100 will be displayed as shown in Figure 31. In the families field 3102, the appropriate family e.g. "05000000:01:01.00.00.00.00" for in-situ concrete works 3104 is selected, followed by the relevant part selection in the parts field 3106, for example "03-pile caps" at 3108. The edit button 3110 is then clicked, and the edit part panel 3200 displayed as shown in Figure 32.

Report components 3202 is selected and the various components are added. Next, the relevant formula is assigned to each of the components in the formula field 3204. For example, for the component "excavation", formula "VOL" for by volume is assigned. As another example, for the component "formwork", the formula "surface area (SA) - surface bottom (SB) - surface top (ST)" is assigned.

The steps described above with reference to Figures 31 and 32 are repeated to assign components and formulas for other designs elements. As described above, in the example embodiment every design element or object being calculated has a part assignment. In turn, every part that is assigned to a design object or element has at least one component linked to the part. Finally, every component that is linked to a part is linked through a relevant valid formula. All or part of the assignments can be maintained such that if a new design is created, the previous assignments can be picked and chosen from pull-down menues from the previously created databases and accepted. Alternatively, new assignments can be added to the databases.

It will be appreciated by a person skill in the art that the first and second database components may be build-up progressively as designs are being generated on the BIM software, en-block in a dedicated build-up "session", or both.

Generate bills of quantities

From the user interface 3300 of the BIM software, the quantify icon 3302 is clicked, and the layout button 3304 in the quantify dialog box 3306 clicked as shown in Figure 33.

A report layout dialog box 3400 will be displayed as shown in Figure 34, and File Format, in this case "Excel File" 3402 is selected. The layout dialog box 3400 contains settings that control the output of the report such as which item and attributes are to be reported and in what file format the report is to be saved.

Pressing the Save icon 3404 closes the report layout dialog box 3400. From the quantify dialog box 3306 (Figure 33), any levels of the construction design can be chosen under the Quantified Levels field 3308 (Figure 33). The start button 3310 (Figure 33) is then clicked to begin the quantification process. The report can be saved under an appropriate folder when the Save Report Files As dialog box 3500 shown in Figure 35 appears. The saved report can be viewed by selecting the correct folder and file name, and the report may be viewed in the "summary" sheet 3600 in a report results Excel window 3602 as shown in Figure 36.

From the menu bar 3700, Tools > Macro > Macros 3702 is selected as shown in Figure 37. Next, the Macro name, in this case, "thirdResult" is selected in the macro dialog box 3800, and then the run button 3802 is clicked as shown in Figure 38. Next, the Format BQ dialog box 3900 appears as shown in Figure 39, and the start button 3902 is pressed to initiate the bill of quantities generation. With reference to Figure 40, upon completion of generation of the bill of quantities report 4000, the OK button 4002 in dialog box 4004 is pressed to confirm completion of the report generation. The bill of quantities 4000 will be generated under different worksheets e.g. 4006, 4008. It is noted that the above process described with reference to Figures 33 to 40 should be repeated whenever there is an amendment or variation to the designs, quantities and specifications.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiment without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

For example, while in the example embodiment first and second database components are implemented for providing the standard-based description information utilised in the automated generation of bill of quantities, it will be appreciated that a single component database may be implemented directly in an objected oriented design software such that a sufficient number of levels is provided in that single component database for storing the desired level of standard-based information linked to the design objects.

CLAIMS

1. A system for generating a bill of quantities associated with a construction project, the system comprising:

a first database for storing object oriented design data representing the construction project;

a second database for storing a standard-based description associated with respective objects in the object oriented design data, the standard-based description identifying standardised object properties associated with corresponding construction objects in the construction project; and

a generator for generating the bill of quantities based on the bill of qualities description library.

2. The system as claimed in claim 1, wherein the second database comprises first and second database components, the first database component for storing standard-based identification codes associated with the respective design objects in the object oriented design data, and the second database component for storing standard-based description information associated with corresponding construction objects in the construction project indexed by the same standard-based identification codes.

3. The system as claimed in claim 2, wherein the first database component further stores a first part of a total of the standard-based description information, and the second database component stores a second part of the standard-based description information.

4. The system as claimed in claim 3; further comprising a first application macro for defining the standard-based identification codes and the first part of the standard-based description information for selected design objects for storing in the first database component.

5. The system as claimed in claims 3 or 4; further comprising a second application macro for defining the second part of the standard-based description information for selected design objects for storing in the second database component.

6. The system as claimed in any one of the preceding claims, further comprising an object oriented design module coupled to the first data base for generating the object oriented design data.

7. The system as claimed in any one of the preceding claims, wherein the second database further stores non-standardised description elements chosen for further facilitating generating the bill of quantities.

8. The system as claimed in any one of the preceding claims, further comprising an assignment module for assigning selected data from the second database to respective objects in the object oriented design data and for assigning formulas for quantity take-off.

9. A method for generating a bill of quantities associated with a construction project, the method comprising:

storing object oriented design data representing the construction project in a first database;

storing a standard-based description associated with respective objects in the object oriented design data in a second database, the standard-based description identifying standardised object properties associated with corresponding construction objects in the construction project; and

generating the bill of quantities based on the bill of qualities description library.

10. The method as claimed in claim 9, wherein the second database comprises first and second database components, the method comprises storing standard-based identification codes associated with the respective design objects in the object oriented design data in the first database component, and storing standard-based description information associated with corresponding construction objects in the construction project indexed by the same standard-based identification codes in the second database component.

11. The method as claimed in claim 10, further comprising storing a first part of a total of the standard-based description information in the first database component, and storing a second part of the standard-based description information in the second database component.

12. The method as claimed in claim 11; further comprising providing a first application macro for defining the standard-based identification codes and the first part of the standard-based description information for selected design objects for storing in the first database component.

13. The method as claimed in claims 11 or 12; further comprising providing a second application macro for defining the second part of the

standard-based description information for selected design objects for storing in the second database component.

14. The method as claimed in any one of claims 8 to 13, further comprising providing an object oriented design module coupled to the first data base for generating the object oriented design data.

15. The method as claimed in any one of claims 9 to 14, further comprising storing non-standardised description elements chosen for further facilitating generating the bill of quantities in the second database.

16. The method as claimed in any one of claims 9 to 15, further comprising assigning selected data from the second database to respective objects in the object oriented design data and assigning formulas for quantity take-off.

17. A data storage medium having stored thereon computer code means for instructing a computer to execute a method of generating a bill of quantities associated with a construction project, the method comprising the steps of:

storing object oriented design data representing the construction project in a first database;

storing a standard-based description associated with respective objects in the object oriented design data in a second database, the standard-based description identifying standardised object properties associated with corresponding construction objects in the construction project; and

generating the bill of quantities based on the bill of qualities description library.